FLIGHT

THE "TOTALLY ENCLOSED" AEROPLANE.

(*Concluded from page* 448.)

HAVING briefly reviewed, in preceding issues of "FLIGHT," the more important of the "enclosed" aeroplanes that have been constructed up to the present, a short *résumé* of the advantages and disadvantages of the different types may be helpful in forming an opinion of the lines along which progress is likely to be made in the future with this type of machine.

Practically speaking, the tractor type of enclosed aeroplane, whether monoplane or biplane, suffers from one common fault, *i.e.*, the view in a forward direction is badly restricted owing to the presence of the engine. In those of the machines reviewed in which the engine was mounted high so as to improve the view to a certain extent, it was generally concluded that the centre of thrust was somewhat too high, thus introducing an aerodynamical disadvantage tending to minimise or even nullify the practical advantage of this arrangement. In the Curtiss Autoplane an attempt has been made to overcome this difficulty by placing the engine in front but very low down, where the pilot can easily look over and beyond, and by employing shaft drive to a propeller placed at the rear end as near as it is possible to judge without knowing results of wind tunnel tests, on or very close to the centre of resistance.

The only "pusher" of the enclosed type, properly speaking, was the Blériot Aerocar, built for Mons. Deutsch de la Meurthe. In this both engine and air screw were placed at the rear, or, in other words, well out of sight as regards the pilot's view, but this machine, it can be easily seen in the light of modern knowledge, suffered from other drawbacks such as excessive head resistance formed by the large flat front of the cabin and by the numerous outriggers carrying front elevator and tail planes. Also the machine was probably too heavily loaded, being of the monoplane type and designed to carry five persons.

Of the large machines that have been or could easily be made "totally enclosed," we have two main types, one represented by the Sikorsky and Handley-Page biplanes, and the other by the Curtiss America type flying boat. Both the latter types are at a distinct advantage as regards "visibility," owing to the fact that they have two engines mounted out on the wings, where they do not greatly obstruct the view. This arrangement is not, however, economical except for large machines, and the inherent advantages of it will therefore scarcely be available for the small single seater or two-seater limousine of the future.

With regard to future development. It is always dangerous to venture to prophesy, more so, probably, in reference to matters aeronautical than in any other branch of science, but with due regard to such improvements as appear likely to be made in the way of engine and aeroplane efficiency, it may be possible to eliminate the types that appear least promising, and to indicate lines along which progress would appear to be most easily made.

It has already been stated that the ordinary tractor type with direct drive and having engine and air screw placed in front suffers from serious drawbacks owing to the obstruction formed by the comparatively large bulk of the engine directly in front of the occupants. It is possible that by somewhat re-designing this arrangement a serviceable machine of this type may be produced. For instance, take an enclosed biplane. If the engine is placed well down in the body and the seats of the occupants are situated fairly high in the body, say, for the sake of argument, so high that their heads are nearly touching the roof of the cabin, the resultant centre of gravity, especially if the tanks are also placed high, should not be so low as to render the machine difficult to handle. The Morane-Saulnier parasol monoplanes have already demonstrated that it is no serious drawback to have even a very low centre of gravity. The air screw could, by employing a suitable form of transmission—and this is a subject which, to our way of thinking, should be given the very greatest consideration since, up to the present, little has been done in this respect—be so placed as to coincide with the centre of resistance. The obstruction to visibility caused by a revolving propeller is comparatively unimportant, even when the engine is throttled down, as it would be when the machine was landing. Incidentally this arrangement, with the engine in front and low down, and the passengers to the rear of and above the engine, would be one of the safest imaginable in the case of a bad landing. A small, and by small we mean a single-seater or a two-seater, monoplane or biplane of this type would appear to be quite a reasonable proposition. The form of engine best suited for this purpose would probably be a vertical or Vee water-cooled, as this could be more easily hidden away in the lower part of the body than could any air-cooled engine, whether of the radial, rotary, or Vee type.

Another arrangement suitable for a small machine is that originated by the Curtiss firm with their Autoplane. From the point of view of visibility this arrangement is excellent, and with the engine in front and a long and necessarily fairly sturdy shaft running through the whole length of the cabin, it should be a very safe one in case of accidents. Although the Curtiss firm are fitting triplane wings to their machine, it does not necessarily follow that this is the only possible arrangement, although the triplane lends itself very well to it. It is conceivable that biplane, or even monoplane, wings could be employed. Until the Curtiss Autoplane has flown and one knows something about its behaviour in the air, it is difficult to form an opinion of the merits, aerodynamically speaking, of this arrangement, which is certainly very promising in other respects.

As we have already pointed out, the Blériot Aerocar is, so far, the only representative of the true "pusher" type of machine having both engine and air screw placed at the rear. A development of this type, which obviously suggests itself, is to employ biplane wings as in the ordinary "pusher" biplane, and to make the *nacelle* totally enclosed, the tail planes being carried on an outrigger in the usual way. By making the *nacelle* rounded in front, its sides gradually flattening out towards the rear, where it would terminate in a vertical knife edge of nearly the same length as the gap between the planes, the added side area in front should not make the machine spirally unstable, as the flat sides towards the rear would counteract the rounded side area of the nose. By fitting windows in the nose, sides, roof and floor of the cabin, a very good view could be obtained in all directions. Here again the engine would for preference be of the water-cooled type, as the cooling of an air-cooled motor at the rear might be attended with some difficulty in view of the shape of the rear of the *nacelle*. Unless objection is taken to having an engine behind one in the case of an accident, this arrangement would appear quite feasible, and, in practice, the "pusher" type without the totally enclosed *nacelle* does not seem to have proved so dangerous from this source as most people were inclined to imagine. Between the three types indicated above there should be ample scope for variety and originality, and developments are likely to be made with all of these.

We now come to deal with the large enclosed machine. Here the feature of enclosing will come as a matter of course, since this type of aeroplane will be used for flights of long duration, and already lends itself extremely well to closing in, on account of the fact that the engines are placed on the wings. There appears to be good reason to believe that, as the machines grow in size and carrying capacity, multiplanes will prove of advantage, and it will, in all probability, be along these lines that the large machines of the Handley-Page and Sikorsky type will develop. In the case of the flying boat it is less simple to fit multiplanes, as the position of the lower wing is limited in a downward direction, and any addition of wings will result in a low centre of gravity. For certain classes of work there does not appear to be any objection to providing the Handley-Page and Sikorsky type with floats so as to convert them into seaplanes, although the time is scarcely ripe to venture an opinion of the relative merits for open sea work of the seaplane and flying boat types.

It would thus appear probable that the transcontinental and transoceanic mail carrying aeroplanes of the future will be of the multi-engined and multiplane type, since the employment of several engines tends to make for greater reliability and more than two pairs of superimposed wings are structurally economical, especially for very large machines. Already existing machines form a very good basis to work upon, and the long-distance aeroplane is held by many authorities to be a mechanical possibility at the present time.

That the enclosed aeroplane will have to come cannot be doubted, not only because in the future flights of much longer duration than are common at present will be made, but also because for comfortable flying—apart, of course, from racing and other flying sports, for which the open type will still be employed in order to get better performance—it is not very enjoyable to sit with one's nose in a draught of anything from 70 to 100 m.p.h. Manufacturers are at present too busily engaged on meeting the more immediate demands of the flying services for war purposes, but when peace shall again reign there will be enormous development in sporting and commercial aeronautics, and the manufacturer who is far-sighted enough to realise its possibilities will lose no time in getting his drawing office staff to work on the development of the peace time machine.